

CHAPTER I - OPERATIONAL PROCEDURES

1. GENERAL

The Joint Typhoon Warning Center (JTWC) provides a variety of routine services to the organizations within its area of responsibility, including:

- a. Significant Tropical Weather Advisories: issued daily, this product describes all tropical disturbances and assesses their potential for further development;
- b. Tropical Cyclone Formation Alerts: issued when synoptic, satellite and/or aircraft reconnaissance data indicate development of a significant tropical cyclone in a specified area is likely;
- c. Tropical Cyclone Warnings: issued periodically throughout each day for significant tropical cyclones, giving forecasts of position and intensity of the system; and
- d. Prognostic Reasoning Messages: issued twice daily for tropical storms and typhoons in the western North Pacific; these messages discuss the rationale behind the most recent warnings.

The recipients of the services of JTWC essentially determine the content of JTWC's products according to their ever-changing requirements. Thus, the spectrum of the routine services is subject to change from year to year; such changes are usually the result of deliberations held at the Annual Tropical Cyclone Conference.

2. DATA SOURCES

a. COMPUTER PRODUCTS:

A standard array of synoptic-scale computer analyses and prognostic charts are available from the Fleet Numerical Oceanography Center (FLENUMOCEANCEN) at Monterey, California. These products are provided via the Naval Environmental Data Network (NEDN).

b. CONVENTIONAL DATA:

This data set is comprised of land-based and shipboard surface and upper-air observations taken at or near synoptic times, cloud-motion winds derived twice daily from satellite data, and enroute meteorological observations from commercial and military aircraft (AIREPS) within six hours of synoptic times. Conventional data charts are prepared daily at 0000Z and 1200Z using hand- and computer-plotted data for the surface/gradient and 200 mb (upper-tropospheric) levels. In addition to these analyses, charts at the 850, 700, and 500 mb levels are computer-plotted from rawinsonde/pibal observations for the 12-hour synoptic times.

c. AIRCRAFT RECONNAISSANCE:

Aircraft weather reconnaissance data are invaluable for the position of the center of developing systems and essential for the accurate determination of numerous

parameters, including;

- eye/center temperature and dewpoint
- maximum surface and flight level wind
- minimum sea level pressure
- horizontal wind distribution

In addition, wind and pressure-height data at the 500 and/or 400 mb level, provided by the aircraft while enroute to, or from fix missions, provide a valuable supplement to the all too sparse data fields of JTWC's area of responsibility. A comprehensive discussion of aircraft weather reconnaissance is presented in Chapter II.

d. SATELLITE RECONNAISSANCE:

Meteorological satellite data obtained from Defense Meteorological Satellite Program (DMSP), and National Oceanic and Atmospheric Administration (NOAA), spacecraft played a major role in the early detection and tracking of tropical cyclones in 1983. A discussion of the role of these programs is presented in Chapter II.

e. RADAR RECONNAISSANCE:

During 1983, as in previous years, land radar coverage was utilized extensively when available. Once a tropical cyclone moved within the range of land radar sites, their reports were essential for determination of small scale movement. Use of radar reports during 1983 is discussed in Chapter II.

3. COMMUNICATIONS

a. JTWC currently has access to three primary communications circuits.

(1) The Automated Digital Network (AUTODIN) is used for dissemination of warnings and other related bulletins to Department of Defense installations. These messages are relayed for further transmission over U.S. Navy Fleet Broadcasts, and U.S. Coast Guard CW (continuous wave Morse code) and voice broadcasts. Inbound message traffic for JTWC is received via AUTODIN addressed to NAVOCEANCOMCEN GUAM or JTWC GUAM.

(2) The Air Force Automated Weather Network (AWN) provides weather data to JTWC through a dedicated circuit from the Automated Digital Weather Switch (ADWS) at Hickam AFB, Hawaii. The ADWS selects and routes the large volume of meteorological reports necessary to satisfy JTWC requirements for the right data at the right time. Weather bulletins prepared by JTWC are inserted into the AWN circuit via the NEDS and the Nimitz Hill Naval Telecommunication Center (NTCC) of the Naval Communications Area Master Station Western Pacific.

(3) The Naval Environmental Data Network (NEDN) is the communications link with the computers at FLENUMOCEANCEN. JTWC is able to receive environmental data from FLENUMOCEANCEN and access the computers directly to run various programs.

b. The Naval Environmental Display Station (NEDS) has become the backbone of the JTWC communications system; it is the terminal that provides a direct interface with the NEDN and AWW; and it is capable of preparing messages for indirect AUTODIN transmission. The NEDS also provides a means for the Typhoon Duty Officer (TDO) to request forecast aids which are processed on the FLENUMOCEANCEN computers and transmitted to the TDO over the NEDN circuit.

4. ANALYSES

A composite surface/gradient level (3000 ft (915 m)) manual analysis of the JTWC area of responsibility is accomplished on the 0000Z and 1200Z conventional data. Analysis of the wind field using streamlines is stressed for tropical and subtropical regions. Analysis of the pressure field is accomplished routinely by the Naval Oceanography Command Center (NOCC) Operations watch-team and may be used in conjunction with JTWC's analysis of tropical wind fields.

A composite upper-tropospheric manual streamline analysis is accomplished daily utilizing rawinsonde data from 300 mb through 100 mb, winds derived from cloud motion analysis, and AIREPS (plus or minus 6 hours) at or above 29,000 feet (8,839 m). Wind and height data are used to arrive at a representative analysis of tropical cyclone outflow patterns, mid-latitude steering currents, and features that may influence tropical cyclone intensity. All charts are hand-plotted over areas of tropical cyclone activity to provide all available data as soon as possible to the TDO. These charts are augmented by the computer-plotted charts for the final analysis.

Computer-plotted charts for the 850, 700, and 500 mb levels are available for streamline or height-change analyses from the 0000Z and 1200Z data base. Additional sectional charts at intermediate synoptic times and auxiliary charts such as station-time plot diagrams and pressure-change charts are also analyzed during periods of significant tropical cyclone activity.

5. FORECAST AIDS

The following objective techniques were employed in tropical cyclone forecasting during 1983 (a description of these techniques is presented in Chapter IV):

a. MOVEMENT

- (1) 12-HR EXTRAPOLATION
- (2) CLIMATOLOGY
- (3) HPAC (Extrapolation/Climatology)
- (4) BPAC (Extrapolation/Climatology)
- (5) CYCLOPS (Steering)
- (6) TYAN78 (Analog)
- (7) ONE-WAY TROPICAL CYCLONE MODEL (Dynamic)
- (8) NESTED TROPICAL CYCLONE MODEL (Dynamic)

- (9) TAPT (Empirical)
- (10) COSMOS (Model Output Statistics)

b. INTENSITY

- (1) THETA E (Empirical)
- (2) WIND RADIUS (Analytical)
- (3) DVORAK (Empirical)

6. FORECAST PROCEDURES

a. INITIAL POSITIONING:

In the preparation of each warning an accurate location (fix) of the tropical cyclone's surface center within two to three hours of warning time is of prime importance. JTWC uses the Selective Reconnaissance Program (SRP) to levy an optimal mix of available resources to obtain the necessary fix information. Whenever a tropical cyclone is poorly defined or the actual surface center cannot be determined, and when conflicting fix information is received, the "best estimate" of the surface location is subjectively determined from the analysis of all available data. If the fix data are not available due to reconnaissance platform malfunctions or communication problems, synoptic data or extrapolation from previous fixes are used. The warning position is then obtained by determining the "best track" of the tropical cyclone up to the last fix, or best estimate of the position of its surface center, and forecasting its movement to the warning time.

b. TRACK FORECASTING:

A preliminary forecast track is developed based on an evaluation of the rationale behind the previous warning and the guidance given by the most recent objective techniques and numerical prognoses. This preliminary track is subjectively modified based on the following considerations:

(1) The prospects for recurvature or erratic movement are evaluated. This evaluation is based primarily on the present and forecast, positions and amplitudes of the middle-tropospheric, mid-latitude troughs as depicted on the latest upper air analyses and numerical prognoses.

(2) Determination of the best steering level is partly influenced by the maturity and vertical extent of the tropical cyclone. For mature tropical cyclones located south of the subtropical ridge, forecast changes in speed of movement are closely correlated with anticipated changes in the intensity or relative position of the ridge. When steering currents are relatively weak, the tendency for tropical cyclones to move northward due to internal forces is an important consideration.

(3) Over the 12- to 72-hour forecast period, speed of movement during the early forecast period is usually biased toward persistence, while the subsequent forecast periods are biased toward objective

techniques. When a tropical cyclone moves poleward, and toward the mid-latitude steering currents, speed of movement becomes increasingly more biased toward a selective group of objective techniques capable of estimating significant increases in speed of movement.

(4) The proximity of the tropical cyclone to other tropical cyclones is closely evaluated to determine if there is a possibility of a Fujiwhara interaction (the apparent rotation of two or more cyclones about a common axis or axes).

A final check is made against climatology to determine whether the forecast track is reasonable. If the forecast deviates greatly from one of the climatological tracks, the forecast rationale may be reappraised.

C. INTENSITY FORECASTING:

In this parameter, heavy reliance is placed on intensity trends from aircraft reconnaissance reports, wind and pressure data from ships and land stations in the vicinity of the tropical cyclone, the Dvorak satellite interpretation model and other objective techniques. An evaluation of the entire synoptic situation is made, including the location of major troughs and ridges, the position and intensity of any nearby tropical upper-tropospheric troughs (TUTT), the vertical and horizontal extent of the tropical cyclone's circulation and the extent of the associated upper-level outflow pattern. An essential element affecting each intensity forecast is the accompanying forecast track and the influence of environmental parameters along that track, such as: sea thermal fronts, terrain influences, vertical wind shear, and an extratropical environment.

Once the forecast intensities have been derived, the horizontal distribution of destructive winds (greater than 30-, 50- and 100-knots) is determined. The most recent wind radii and associated asymmetries are deduced from all available surface wind observations and reconnaissance aircraft reports. Based on the current wind distribution, preliminary estimates of future wind radii are provided by an empirically derived objective technique. These estimates may be subjectively modified based on the anticipated interaction of the tropical cyclone's circulation with forecast locations of large-scale wind regimes and significant landmasses. Other factors including the tropical cyclone's speed of movement and possible extratropical transition are considered.

7. WARNINGS

Tropical cyclone warnings are issued when a definite closed circulation is evident and maximum sustained surface winds are forecast to increase to 34 knots (18 meters per second) within 48 hours, or if the tropical cyclone is in such a position that life or property may be endangered within 72 hours. Warnings may also be issued in other situations if it is determined that there is a need to alert military or civil interests to conditions which may become hazardous in a short period of time.

Each tropical cyclone warning is numbered sequentially and includes the following information: the position of the surface center; estimate of the position accuracy and the supporting reconnaissance (fix) platforms; the direction and speed of movement in the past six hours; the intensity and radial extent of surface winds over 30-, 50-, and 100-knots, when applicable. At forecast intervals of 12-, 24-, 48- and 72-hours, information on the tropical cyclone's anticipated position, intensity and wind radii is also provided.

Warnings in the western North Pacific and North Indian Ocean are issued every six hours valid at standard synoptic times (0000Z, 0600Z, 1200Z and 1800Z). All warnings are released to the communications network no earlier than synoptic time and no later than synoptic time plus two and one half hours so that recipients will have a reasonable expectation of having all warnings "in hand" by synoptic time plus three hours (0300Z, 0900Z, 1500Z and 2100Z).

Warning forecast positions are verified against the corresponding "best track" positions (post-storm analysis to determine actual path). A summary of the verification results from 1983 is presented in Chapter IV.

8. PROGNOSTIC REASONING MESSAGES

For tropical storms and typhoons in the western North Pacific Ocean, prognostic reasoning messages are transmitted following the 0000Z and 1200Z warnings, or whenever the previous reasoning is no longer valid. This plain language message is intended to provide meteorologists with the reasoning behind the latest JTWC forecast.

In addition to this message, prognostic reasoning information applicable to all customers is provided in the remarks section of warnings when significant forecast changes are made or when deemed appropriate by the TDO.

9. SIGNIFICANT TROPICAL WEATHER ADVISORY

This product contains a general, non-technical description of all tropical disturbances in the JTWC area of responsibility and an assessment of their potential for further (tropical cyclone) development. In addition, all tropical cyclones in warning status are briefly discussed. This message is issued by 0600Z daily and is reissued whenever the situation warrants.

10. TROPICAL CYCLONE FORMATION ALERT

Formation alerts are issued whenever interpretation of satellite imagery and other meteorological data indicates that the formation of a significant tropical cyclone is likely. These formation alerts will specify a valid period not to exceed 24 hours and must either be cancelled, reissued, or superseded by a tropical cyclone warning prior to the expiration of the valid time.